Systems and Power
Solutions

Engineering
Design
Construction Management
Program Management

SYSTRA


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Q480
25
MILES

Who We Are

SYSTRA USA (SYSTRA) is an architecture, engineering, and construction management firm that partners with clients to deliver transformative projects for the rail and transit industry.

Throughout four decades of US experience, SYSTRA has garnered an extensive portfolio of projects to improve our nation's rail and transit infrastructure and systems. Our commitments to safety, environmental stewardship, quality, ethics, and sustainability form the bedrock of our daily operations.

Grounded in our corporate value of Connected Teams, SYSTRA ensures our clients and partners have access to the best global talent. Through seamless information sharing, innovative tools, best practices, and streamlined processes, we foster an environment where excellence thrives.

SYSTRA is among the few companies globally with a large workforce dedicated to the rail and transit industry thus we can mobilize international resources whenever necessary.

In addition to working within conventional design-bid-build project structures, SYSTRA excels with the successful delivery of alternative project delivery methods, including design-build, progressive design-build, construction manager/general contractor (CM/GC), and public-private partnerships (PPP). In this evolving and increasingly complex environment, the designer is more essential than ever to help secure and deliver safe, sustainable transportation solutions. SYSTRA is adept at cost reduction, rapid delivery, innovation, alternative technical concepts, safety, and quality. We understand what is at stake during the project life cycle and develop efficient, technically sound, and creative solutions that contractors and owners expect.

As a member of SYSTRA Group, a world-renowned engineering and consultancy, we tap into a vast pool of expertise and resources to deliver tailored solutions that meet the evolving needs of our clients and their communities.

Our Commitments to Clients and Partners

- **Safety:** Make it a priority, train staff, and emphasize corporate commitment.
- **Quality:** Perform work right the first time and conduct independent quality reviews.
- **Schedule Compliance:** Understand the complexities involved in alternative design and construction scheduling.
- **Cost Containment:** Develop contract compliant and cost-effective solutions.
- **Teamwork:** Share responsibility, lead effectively, and trust in project execution.
- **Access to Executives:** Communicate directly with decision makers.
- **Risk Management:** Understand how to manage risks on complex projects.
- **Effective Communication:** Understand that early engagement and communication are critical to successful delivery.

SYSTRA in Numbers

- **11,000 employees worldwide:** we harness diverse talents and expertise to drive innovation and excellence in transportation solutions.
- **1,000 railway systems and power specialists:** With our large pool of talent, we can efficiently address the complexities inherent in modern railway train control, signaling, communications, and power systems.
- **65 years of international experience:** SYSTRA has honed our skills and knowledge to become a leader in the engineering and consulting industry.
- **Operating in 80 countries:** SYSTRA's reach spans the globe, enabling us to bring our expertise and solutions to diverse regions and cultures.
- **40+ CBTC projects:** Having successfully delivered over 40 communications-based train control (CBTC) projects, SYSTRA is revolutionizing rail systems with cutting-edge technology and safety advancements.
- **High-speed rail lines on 5 continents:** Pioneering advancements in rapid and efficient transportation, we have contributed to the design of high-speed lines in service and under construction on 5 continents.
- **60% of automatic metros:** A world leader in automatic metros, SYSTRA has 60% of automatic metro lines in service, under construction, or being automated to our credit.

Systems Engineering

SYSTRA's distinctive systems engineering approach begins by defining operations, maintenance, safety, and performance criteria. Using a comprehensive database, we identify functional and technical requirements at the project's onset, which not only mitigates risks but also saves time and cost.

Benefitting from SYSTRA's extensive knowledge base, we expedite the design phase by entering client's requirements into our systems model to manage interfaces and integration and minimize risks. Supported by robust and collaborative processes, we offer:

- **Requirements Management:** Ensuring comprehensive coverage, we trace requirements from operations and maintenance to safety policy identification, down to subsystem design.
- **Configuration Management:** Guaranteeing alignment between delivered baselines and expected content, SYSTRA's process ensures that modifications are agreed upon, controlled, and shared among stakeholders in real-time.
- **Functional Apportionment:** We eliminate overlaps, loopholes, and inconsistencies, ensuring the seamless integration of all components.
- **Interface Management:** This enhances processes through responsible allocation according to technical discipline delivery scope.
- **V-cycle and Quality Gates:** This ensures that the systems are at an optimal level of maturity before advancing to the next delivery phase throughout the project lifecycle.
- **System Assurance:** This ensures operating performance, contributing to timely and cost-efficient delivery. This encompasses Reliability, Availability, Maintainability (RAM), system safety, cybersecurity, human factors and ergonomics, and security assurance.

California High-Speed Rail Merced to Madera Project

SYSTRA is a key member of the team designing the 34.3-miles from Merced Station to the northern limits of CP-1 in Madera. SYSTRA is leading the tasks related to systems engineering and systems integration and providing structural and seismic support for the project that features 40 structures.

The initial phase of the project involves establishing the right-of-way required for the guideway, including provisions for roadway, agricultural irrigation, systems facilities, waterways, and wet and dry third-party utility crossings. It is expected to conclude in March 2025.

The second phase has been officially released and focuses on Stage 4. It involves the preparation of 60%, 90%, and Ready for Construction (RFC) drawings for all project elements.

LA Metro Operations Control Centers Systems Assessment and Feasibility Study

SYSTRA is a key member of the team providing on-call systems engineering design and related services to support rail and bus capital and state of good repair projects. Under this contract, SYSTRA is comprehensively assessing the current and future operational needs of LA Metro's control centers. Through a structured methodology encompassing a needs assessment, spatial concept of operations (ConOps), and existing conditions assessment, SYSTRA provided actionable recommendations for the development and enhancement of these critical facilities.

These outputs are being informed by industry best practices and tailored to support LA Metro's growth trajectory over the next 50 years.

The study will leverage technology and innovation to maximize efficiencies, enhance communications, improve response times, streamline interdepartmental activities, and elevate service delivery to LA Metro's customers.

Systems **Integration**

In any project lifecycle, unexpected challenges can arise, potentially leading to rework. A robust systems integration strategy is paramount to preempting such setbacks. Systems integration ensures that post-assembly, the system meets initial expectations within defined timeframes and budgets.

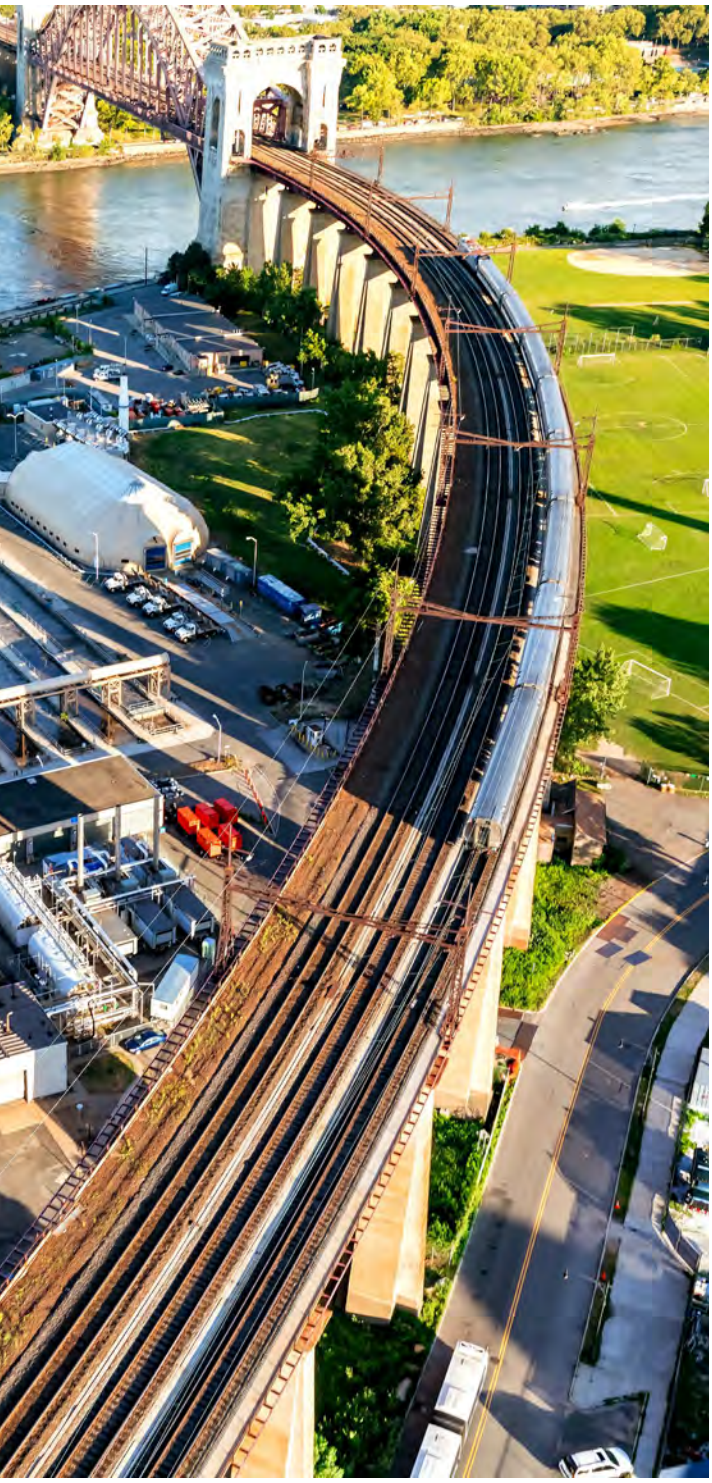
Leveraging over 60 years of global project experience, SYSTRA ensures comprehensive systems integration at every project stage, from planning to design to testing and commissioning.

Designing complex systems involves integrating multiple technologies. Our systems engineering approach ensures optimal performance, efficient service delivery, and compliance with requirements.

SYSTRA's systems integration expertise is underpinned by a mature systems engineering framework, seasoned project managers, and processes refined through decades of experience from working on signature projects worldwide. Our proficiency in complex interconnected systems is honed through numerous bus, commuter rail, conventional rail, light rail, mass rapid transit, and high-speed rail projects.

Our dedicated testing and commissioning experts thoroughly plan, direct, and oversee the testing process that includes:

- Defining activities from factory testing, sequencing, and associated timelines.
- Supervising and controlling testing and commissioning tasks until handover to the client and commencement of revenue service.
- Ensuring system test readiness, encompassing the test environment, stakeholder requirements, and safety considerations.



New York MTA Penn Station Access

This transformative transportation infrastructure project will establish Metro-North service directly from the Bronx, Westchester, and Connecticut to Penn Station and Manhattan's West Side. The team is slated to complete this $1.85 billion design-build project in just over five years.

SYSTRA is the designer of record of signals installation, traction power/catenary, and stray current and corrosion control, as well as is supporting the communications system and track designs and performing positive train control (PTC) radio propagation studies. SYSTRA is leading the systems integration and safety/security certification of the overall system design, to ensure the seamless operation and network reliability.

Our traction power and OCS work includes upgrading traction power substation facilities and designing two new 138 kV traction power substations, new wayside power facilities and new signal power substations, and the new OCS system.

The new line will run the Advanced Civil Speed Enforcement System (ACSES) 2 positive train control (PTC) system. SYSTRA is applying our insight and expertise to secure FRA certification, which is very complex given the size of the project and myriad stakeholders involved that include Metro-North, AMTRAK, Long Island Rail Road, and CSX Railroad.

Penn Station Access will provide four new accessible stations in the East Bronx, 19 miles of track, and new substations, as well as reconfiguration of the New Rochelle train yard and modernization of signals and communications technology.

Revitalization of AMTRAK's Hell Gate Line is also part of the work, which not only enhances reliability and on-time service for intercity passengers but also lays the groundwork for future high-speed rail initiatives.

Advanced Train Control Systems

Transitioning to modern signaling systems offers owners and operators opportunities to enhance network capacity, resilience, and efficiency, while reducing human intervention and operational expenses. For example, automated rail lines can significantly decrease power consumption, thereby lowering carbon footprints.

To ensure a seamless transition, SYSTRA formulates a comprehensive strategy at the project's outset, leveraging expertise from all relevant subsystems throughout the project lifecycle. Factors such as obsolescence, operations, and cost are carefully considered.

Understanding the technological gap between conventional signaling systems and advanced solutions like communications-based train control (CBTC) and PTC is essential to successful migration to driverless or unattended systems.

While countries in Europe and Asia have employed cutting-edge transit technologies for years, these advancements have been slower to reach the United States. Employing international expertise, we are spearheading initiatives to modernize American rail and transit networks. Notable collaborations include partnering with the New York Metropolitan Transportation Authority (MTA) on its CBTC Modernization Program since 2015 and with San Francisco Bay Area Rapid Transit (BART) to advance its program since 2020. Through these endeavors, SYSTRA is not only driving technological advancement but also revolutionizing the landscape of transit safety and efficiency in American cities.

SYSTRA offers a range of services, including:

- Development of investment strategies and plans.
- Preparation of robust operating plans for individual lines, groups of lines, or entire networks.
- Assessment of line conditions regarding technology obsolescence and unused capacity.
- Cost estimation and value analyses.
- Preliminary and basic design.
- Optimization of phasing to minimize operational impacts.
- Integration of subsystems.
- Assessment of rolling stock acceptance for new onboard technologies.
- Evaluation of systems requirements to enhance the transportation network.
- Migration to Grade of Automation levels 2 to 4 (unattended).
- RAM analyses.
- Safety and security analyses.
- Data management.
- Regulatory and agency compliance.
- Development of test strategies and plans.
- Static and dynamic testing.
- Factory and site acceptance testing.
- Construction supervision.

Leaders in Train Control Modernization

BART CBTC Modernization Program

SYSTRA is leading the team providing design services during construction for the deployment of Bay Area Rapid Transit's (BART) communications-based train control (CBTC) system. This will modernize the BART system, enhancing its capacity, reliability, and overall customer satisfaction for the next three decades and beyond.

One of the most complex train control modernization programs in North America, this project is important to BART's operational efficiency and growth of the Bay Area.

Integrated with the BART project team, SYSTRA is responsible for design support, program management, project controls, and administrative support. Our primary objectives revolve around facilitating the implementation of Hitachi's CBTC design-build contract, ensuring adherence to specifications, industry standards, and alignment with established operational and performance benchmarks.

Our team is also leading the vehicle integration elements and providing the support and analysis to uphold the project schedule and budget and minimize disruptions to revenue service.

We are playing a pivotal role in ensuring seamless integration between the new train control system and additional modernization efforts such as station upgrades and wireless network enhancements.

Our work is helping to create a more efficient and reliable system to provide an improved passenger experience.

MTA Queens Boulevard Line and 8th Avenue Line CBTC Signaling System Modernization

To enhance service reliability and efficiency along Queens Boulevard Line (QBL) within the New York City Transit (NYCT) system, the MTA is deploying state-of-the-art communications-based train control (CBTC) technology.

To ensure the seamless integration and successful implementation of the CBTC system, SYSTRA has been overseeing the entire lifecycle of the project, from design and procurement to construction support services. In addition, we are coordinating the auxiliary wayside signal (AWS) systems.

In collaboration with the MTA, SYSTRA developed innovative training simulation methodologies to certify and train over 800 operators. This proactive approach was essential to meeting the aggressive in-service schedule, ensuring that operational readiness aligned with project milestones.

The project is carried out in two parts: QBL West and QBL East. QBL West was characterized by its scale and complexity. Unlike previous CBTC deployments on single lines with a limited number of trains, QBL West encompasses four major lines—E, F, M, and R—serviced by over 1,500 trains. This is also the first time that interoperability between three suppliers (Siemens, Thales, and Mitsubishi) was demonstrated in the US, making the MTA subway system and Paris Metro the only agencies in the world to implement CBTC interoperability.

In addition to our involvement in QBL West, SYSTRA is overseeing the CBTC implementation for QBL East, which involves working with Hitachi, the solid-state interlocking system supplier.

Secure and High-Performance **Communications**

Modern telecommunications systems play a crucial role in enhancing real-time connectivity across all operational facets of transportation networks. They not only facilitate optimized operations and maintenance but also contribute to reducing operational expenditures.

Recognizing the intricacies involved in integrating constantly evolving telecommunications systems into operational environments is essential to minimize disruptions to train movements.

Our Services

- **Develop investment strategies and plans** tailored to new technologies such as 5G.
- **Conduct preliminary and basic design**, including comprehensive systems planning.
- **Supervise construction activities** to ensure seamless implementation.
- **Integrate sub-systems** to ensure efficient interoperability.
- Generate test strategies and plans to validate system performance.
- **Assist in defining performance thresholds, service quality targets, and functional/technical requirements** for new systems, particularly when telecom services need to be shared among various user types.
- **Establish and execute a clearly defined migration plan** to minimize operational disruptions.
- **Investigate and resolve potential interference issues** with neighboring radio systems outside the transport network.
- **Conduct technical and functional testing of telecommunications** systems, including rigorous dynamic testing.

SYSTRA ensures the seamless integration of cutting-edge technologies into transportation networks.

Drawing from the insights gained through our involvement in these groups, we implement best practices and industry standards to enhance the efficiency, reliability, and safety of public transportation systems.

Here's how our collaboration with standardization groups translates into tangible benefits for your network:

- Incorporates latest technologies.
- Ensures interoperability.
- Mitigates interference.
- Enhances safety and security.
- Streamlines deployment processes.

LA Metro Sepulveda Transit Corridor

The Sepulveda Transit Corridor is a major transit project planned to improve transportation in Los Angeles County.

SYSTRA is a key member of the Sepulveda Transit Corridor Partners Team working on what LA Metro refers to as Alternatives 4 and 5 that would advance a rail transit solution to ease congestion on the 405 freeway between the Valley and Westside.

These alternatives are for high-capacity rail lines that would provide fast, green, and connected transit taking riders between the Valley and Westside in less than 20 minutes.

SYSTRA is leading the systems engineering for train control, communications, electrical, and traction power systems. We are developing the functional and performance requirements for communications subsystems aboard transit vehicles, maintenance facilities, guideway structure and eight stations.

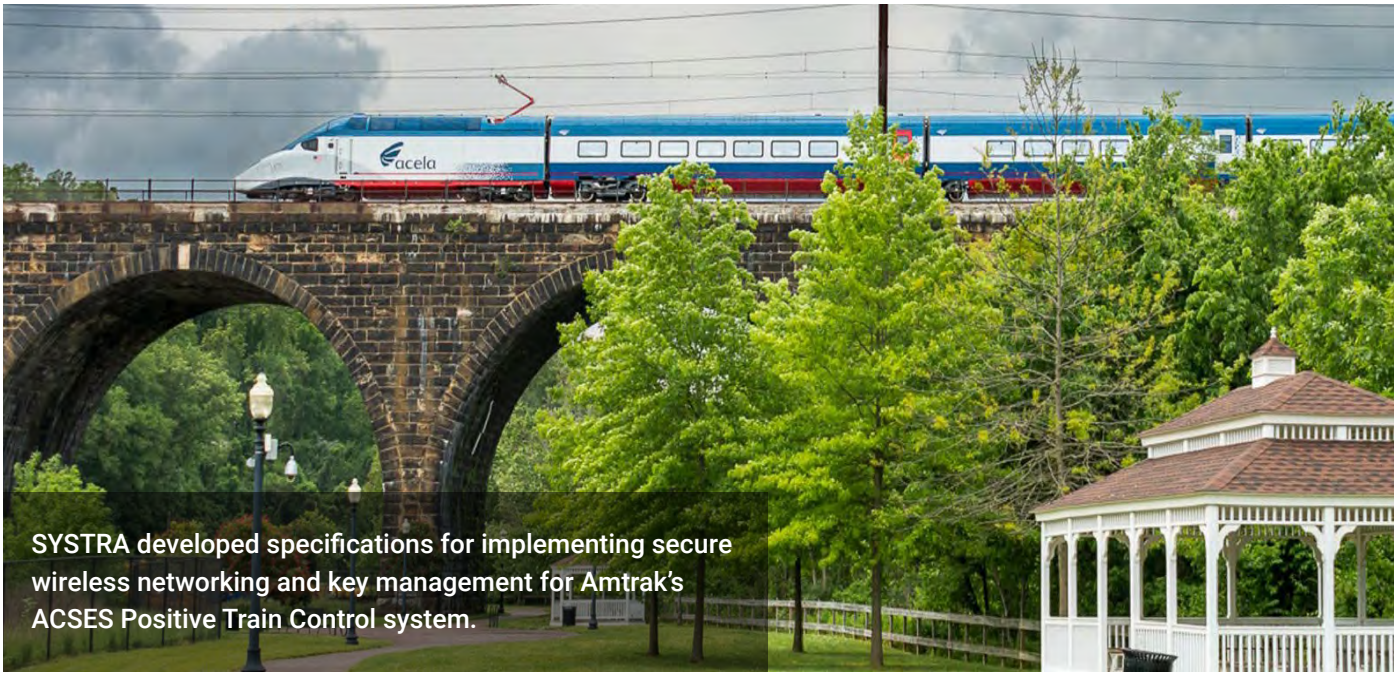
Cybersecurity

By identifying the systems involved, understanding the types of risks, and implementing organizational, human, and technological measures, vulnerabilities can be effectively reduced. This proactive approach is instrumental in preventing a range of potential threats, including theft of sensitive customer data, system shutdowns, collisions and accidents, disruptions to operations, transmission of incorrect information, blockages in passenger flows, unauthorized access, and service stoppages.

By partnering with SYSTRA, transportation stakeholders can fortify their systems against potential threats, safeguard sensitive data, and maintain uninterrupted operations in an increasingly interconnected and digitized environment.

How We Can Help

- **Governance:** We conduct comprehensive risk analyses, formulate robust security policies, and raise awareness about key issues to empower decision-makers and enhance overall resilience.
- **Security by Design:** SYSTRA specializes in defining cybersecurity requirements, conducting design reviews of various systems, and overseeing implementation reviews to ensure that security measures are integrated seamlessly from the outset.
- **Integration of Solutions:** Our experts identify relevant security solutions through meticulous studies, design tailored strategies, and oversee implementation processes to ensure smooth integration and effective change management.
- **Vulnerability Assessment:** We conduct thorough inventories to identify assets and known vulnerabilities, secure legacy systems through targeted inventory management, and ensure compliance with current regulations through rigorous assessments.



SYSTRA developed specifications for implementing secure wireless networking and key management for Amtrak's ACSES Positive Train Control system.

LIRR/Metro-North Positive Train Control Systems

SYSTRA is playing a pivotal role in advancing the Long Island Rail Road (LIRR) and Metro-North Railroad's (Metro-North) Positive Train Control (PTC) initiatives, aligning with the mandates of the Rail Safety Improvement Act of 2008.

Our team spearheaded the development of FRA-approved PTC Implementation and Development Plans, achieving critical milestones such as type approval for the Advanced Civil Speed Enforcement System II (ACSES II) application in non-cab signal territory. Additionally, we developed specifications for the procurement of the PTC systems integrator and provided support in creating the railroad's PTC safety plan. Our expertise extended to performing RF propagation analyses for the 220 MHz spectrum, ensuring optimal functionality and coverage.

Upon plan acceptance, our team seamlessly transitioned into delivering comprehensive design and construction-related services for the PTC systems. This encompassed everything from wayside signal systems to vehicle onboard systems, office systems, and data radio communications infrastructure, ensuring a holistic approach to safety enhancements.

For the LIRR, the team developed contract documents for a new cab signal/ATC system covering 70 miles and provided construction management services for the installation of eight miles of tunnel leaky coax antenna. Similarly, for Metro-North, our team crafted specifications for procuring all PTC equipment and installation requirements, ensuring alignment with railroad standards.

Our involvement extended to the design and construction phase services for a state-of-the-art data center, housed in a sealed environment, has cutting-edge features and CCTV integration with Grand Central Terminal's systems.

We provided construction phase support for signaling systems and managed cable installation contracts. The team also developed specifications for procuring the PTC systems integrator and is overseeing third-party installation of PTC communications cases, antennas, and cabling.

Infrastructure **Security**

Protecting railway infrastructure from physical intrusion and attacks is paramount to ensuring passenger safety and availability of services. By selecting tailored solutions for the specific context, the likelihood and severity of physical attacks can be minimized, improving safety and reducing operational costs. Solutions include access control systems, intrusion detection systems, and intelligent video surveillance systems.

How We Can Help

- **Threat and Vulnerability Assessments:** SYSTRA conducts thorough assessments to identify potential threats and vulnerabilities to railway infrastructure.
- **Stakeholder Coordination:** Facilitating communication and collaboration among stakeholders, including emergency services, SYSTRA works to define comprehensive security requirements.
- **Investment Strategies and Plans:** Our experts develop investment strategies and plans, benchmarking solutions and considering upcoming innovations to ensure cost-effective security measures are implemented.
- **Design and Construction Supervision:** From preliminary planning to basic design and construction supervision, we oversee the implementation of security measures to safeguard railway infrastructure.
- **Integration of Subsystems:** We ensure seamless integration of various security subsystems to create a cohesive and effective security infrastructure.
- **Test Strategies and Plans:** SYSTRA develops comprehensive test strategies and plans to verify the effectiveness and reliability of security measures.

New York MTA Integrated Electronic Security System

SYSTRA was the commissioning agent for MTA's Integrated Electronic Security System, a large endeavor to put security systems throughout MTA properties following 9/11.

SYSTRA provided security system engineering design and implementation support services. The work included designing all aspects of security systems and command, control, and communications (C3) Centers, and implementing them for all MTA agencies. C3 centers were designed and constructed to provide interoperability and situational awareness. Security surveillance, access control, and intrusion detection systems were implemented for a variety of infrastructure.

As the commissioning agent, SYSTRA ensured all elements of the program (contractor and agency) were appropriate and sufficient to achieving the project's objectives, including all program plans and processes, systems and facility designs, manufacturing processes, assembly, and unit testing, installation practices and procedures, test programs and procedures, testing witnessing, training, security policy development, and transition and commissioning.

Systems **Assurance**

Systems assurance plays a critical role in planning systematic engineering activities to ensure that products meet all applicable systems requirements.

Our comprehensive approach extends beyond traditional Reliability, Availability, Maintainability, and Safety (RAMS) considerations to include elements such as human factors and fire and life safety.

SYSTRA's comprehensive approach to systems assurance ensures that railway infrastructure and operations meet the highest standards of safety, reliability, and performance.

By adopting an overarching systems assurance approach, discrepancies and gaps are minimized during systems integration, and each subsystem/ contractor is held to the same high standard of evidence from design to implementation.

Our Services

- **Independent Safety and RAM Expertise:** We offer independent expertise in safety and RAM to ensure that all aspects of systems assurance are thoroughly addressed.
- **Comprehensive Involvement:** SYSTRA's services cover all subsystems, ensuring holistic coverage of systems assurance requirements.
- **Early Intervention:** Our team intervenes early in the design phase to incorporate system requirements such as RAMS, human factors, and fire and life safety, thereby mitigating risks and ensuring adherence to standards.
- **Demonstration of Performance:** We facilitate the demonstration of performance metrics, including RAM and safety, at an early stage to identify and address potential issues.
- **Risk Reduction:** Through systematic risk assessment and mitigation strategies, we work to reduce risks associated with systems assurance and overall project delivery.
- **Human Factors and Fire and Life Safety:** Our expertise extends to human factors and fire and life safety considerations, ensuring that these critical aspects are integrated seamlessly into the systems assurance framework.

ATS *and* SCADA Supervisory Systems

Supervisory systems for energy and transportation play a critical role in ensuring smooth service preparation and delivery, optimizing operations, and enhancing customer service. These systems:

- **Facilitate Complex Operations:** Efficient supervisory systems with user-friendly human-machine interfaces streamline complex operations, enhancing operational efficiency.
- **Enable Quick Decision-Making:** By providing accurate, real-time, and manageable information during incidents and alarm flows, these systems empower operators to make informed decisions swiftly.
- **Support Data Analysis:** Supervisory systems facilitate data analysis for accurate reporting and identification of performance enhancement solutions, contributing to continuous improvement.

SYSTRA is committed to defining and improving supervisory systems to enhance real-time decision-making, optimize operations, and elevate customer service standards across energy and transportation sectors.

SYSTRA's project portfolio features over 20 control center projects, which is more than most industry partners.

How We Can Help

- **Use Market Knowledge:** Employing our expertise and constant screening of innovative solutions, SYSTRA proposes relevant supervisory system solutions tailored to specific operational needs.
- **Develop Long-Term Plans:** We assist in developing long-term investment and maintenance plans, managing obsolescence, and ensuring interoperability between systems to future-proof infrastructure.
- **Undertake Systems Integration:** SYSTRA prepares and undertakes the seamless integration of new systems and migration processes, ensuring continuity of service and minimizing disruptions.
- **Propose Virtualization and Evolution Plans:** We recommend virtualization and long-term evolution plans to reduce dependency on proprietary systems, enhancing flexibility and scalability.
- **Implement Verification and Validation Plans:** Our team prepares and implements robust verification and validation plans to ensure the reliability and effectiveness of supervisory systems.

Passenger **Information**

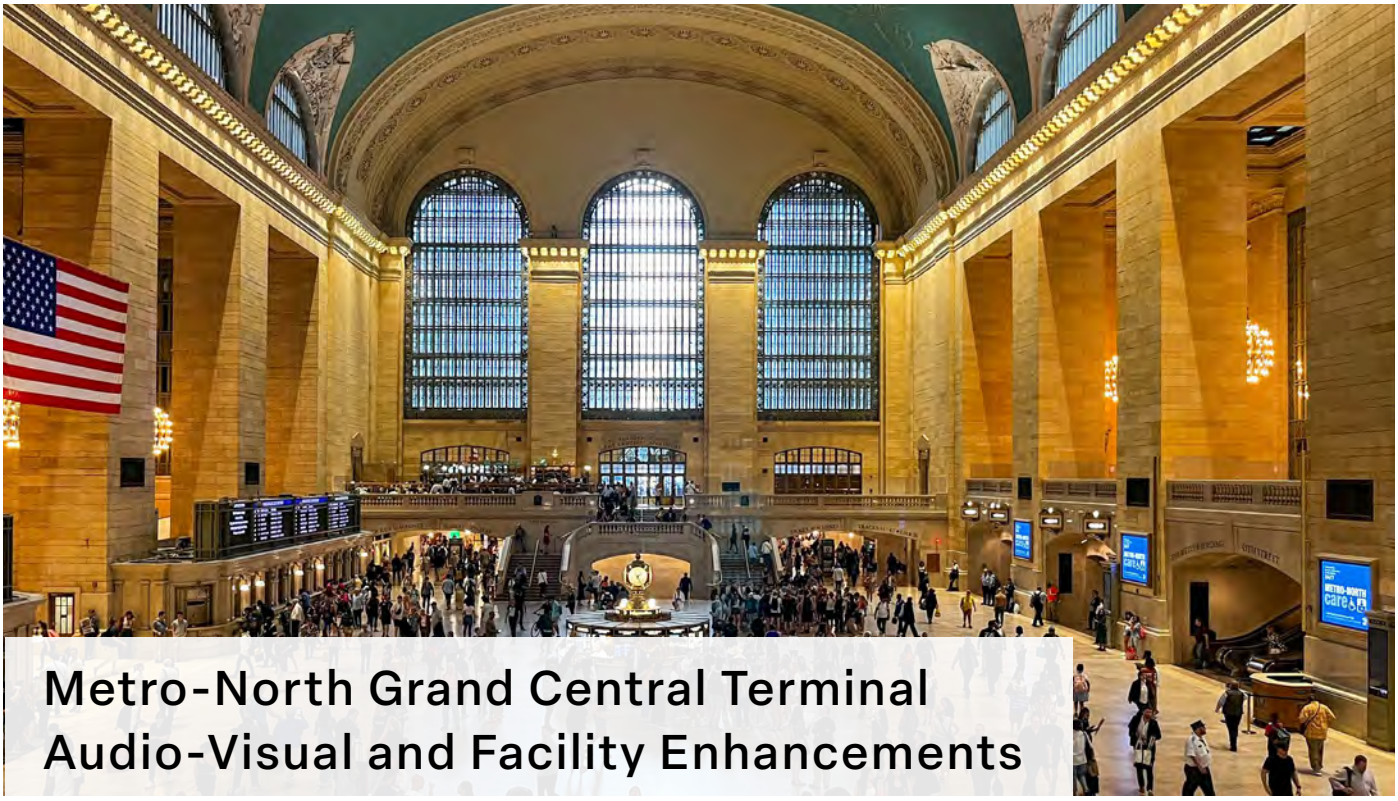
Passengers want to make the most of their time spent on the public transportation network. Whether waiting at a light rail station or riding on a mass transit system, passengers need real-time information about their journey and the ability to work and engage in leisure activities.

Enhancing the passenger experience involves providing comprehensive passenger information displays and ensuring continuous internet connectivity. These measures can significantly elevate customer satisfaction levels.

SYSTRA helps stakeholders elevate passenger satisfaction levels through enhanced information displays and seamless internet connectivity, fostering a positive and productive travel experience.

SYSTRA's Services

- Develop Investment Strategies and Plans: SYSTRA assists in developing investment strategies and plans tailored to enhance passenger experience, ensuring optimal allocation of resources.
- Agreements with Third Parties: We facilitate the negotiation and establishment of agreements with third parties, such as mobile network operators, to ensure seamless and reliable internet connectivity throughout the transportation network.
- Preliminary and Basic Design: Our team conducts preliminary and basic design processes, including radio network coverage planning, to lay the foundation for effective implementation of passenger information and internet connectivity solutions.
- Construction Supervision: SYSTRA provides construction supervision services to ensure that infrastructure developments align with design specifications and meet quality standards.
- Integration of Sub-Systems: We oversee the integration of various sub-systems, ensuring seamless interoperability and functionality across the entire passenger information and connectivity network.
- Test Strategies and Plans: Our experts develop comprehensive test strategies and plans to validate the performance and reliability of passenger information displays and internet connectivity solutions.
- Definition of Performance Thresholds and Service Quality Targets: SYSTRA collaborates with stakeholders to define performance thresholds and service quality targets, ensuring that passenger experience enhancements meet predefined benchmarks and expectations.



Metro-North Grand Central Terminal Audio-Visual and Facility Enhancements

Metro-North embarked on a comprehensive customer service initiative (CSI) across Grand Central Terminal (GCT), its outlying passenger stations, and associated facilities to enhance the information available to travelers.

A member of the design-build team, SYSTRA led the design of all audio and visual information systems. This encompassed the design and implementation of copper and fiber optic-based network connectivity, facilitating seamless communication between the public address and visual information head end systems throughout GCT.

Our scope also included structural analysis and electrical design of customer information displays, including the iconic Big Board, gate boards, train arrival/departure boards, and employee monitors.

SYSTRA also oversaw network connectivity of security systems and elevator/escalator management throughout the terminal.

Navigating the complexities of working in one of the world's busiest passenger terminals posed unique challenges.S

SYSTRA adopted a collaborative approach, working closely with installers and other project stakeholders through regular construction meetings.

Emphasizing a harmonious integration with the terminal's aesthetic, SYSTRA's structural and site designs seamlessly blended with existing elements while ensuring durability and ease of maintenance.

We conducted site inspections to ensure adherence to project sequencing and quality standards.

Clear communication and coordination were paramount, necessitating robust procedures and ongoing dialogue with stakeholders, contractors, and Metro-North staff alike.

Rolling Stock

Rolling stock stands as a pivotal investment decision for operators, with a lifecycle spanning 30 to 40 years and serving as a primary determinant of passenger experience. This capital expenditure plays a crucial role in the commercial success of operators, with safety, performance, comfort, reliability, and lifecycle costs directly impacting profitability.

With a customer-centric approach to operation and maintenance, SYSTRA collaborates closely with operators to propose tailored solutions that perfectly align with their business objectives, enhancing operational efficiency and passenger experience.

Our Services

- Independent Safety Assessment: SYSTRA serves as an independent safety assessor, ensuring compliance with stringent safety standards to enhance passenger and operational safety.
- Investment Strategies and Plans: Leveraging our extensive experience and knowledge of various rolling stock types, we develop tailored investment strategies and plans to optimize fleet composition and deployment.
- Feasibility Studies Support: We provide support for feasibility studies by offering up-to-date information on vehicle availability, state-of-the-art functionalities, performance metrics, comfort levels, as well as capital and operational expenditure considerations.
- Preliminary Design: Our team conducts preliminary design processes with a focus on optimizing performance, ensuring that rolling stock configurations align with operational requirements and passenger expectations.
- Bid Specifications Preparation: SYSTRA assists in preparing comprehensive bid specifications, ensuring that procurement processes are efficient and aligned with project objectives.
- Construction Supervision: We oversee construction activities to ensure adherence to design specifications, quality standards, and project timelines, mitigating risks and optimizing project outcomes.
- Test Strategies and Plans: Our experts develop robust test strategies and plans to validate the performance, safety, and reliability of rolling stock, ensuring compliance with regulatory requirements and industry standards.
- Rolling Stock Assessment: We assess existing rolling stock in operation, identifying opportunities for optimization, modernization, or replacement to enhance fleet efficiency and passenger satisfaction.

Austin Transit Partnership Project Connect Program Manager/Owner's Representative

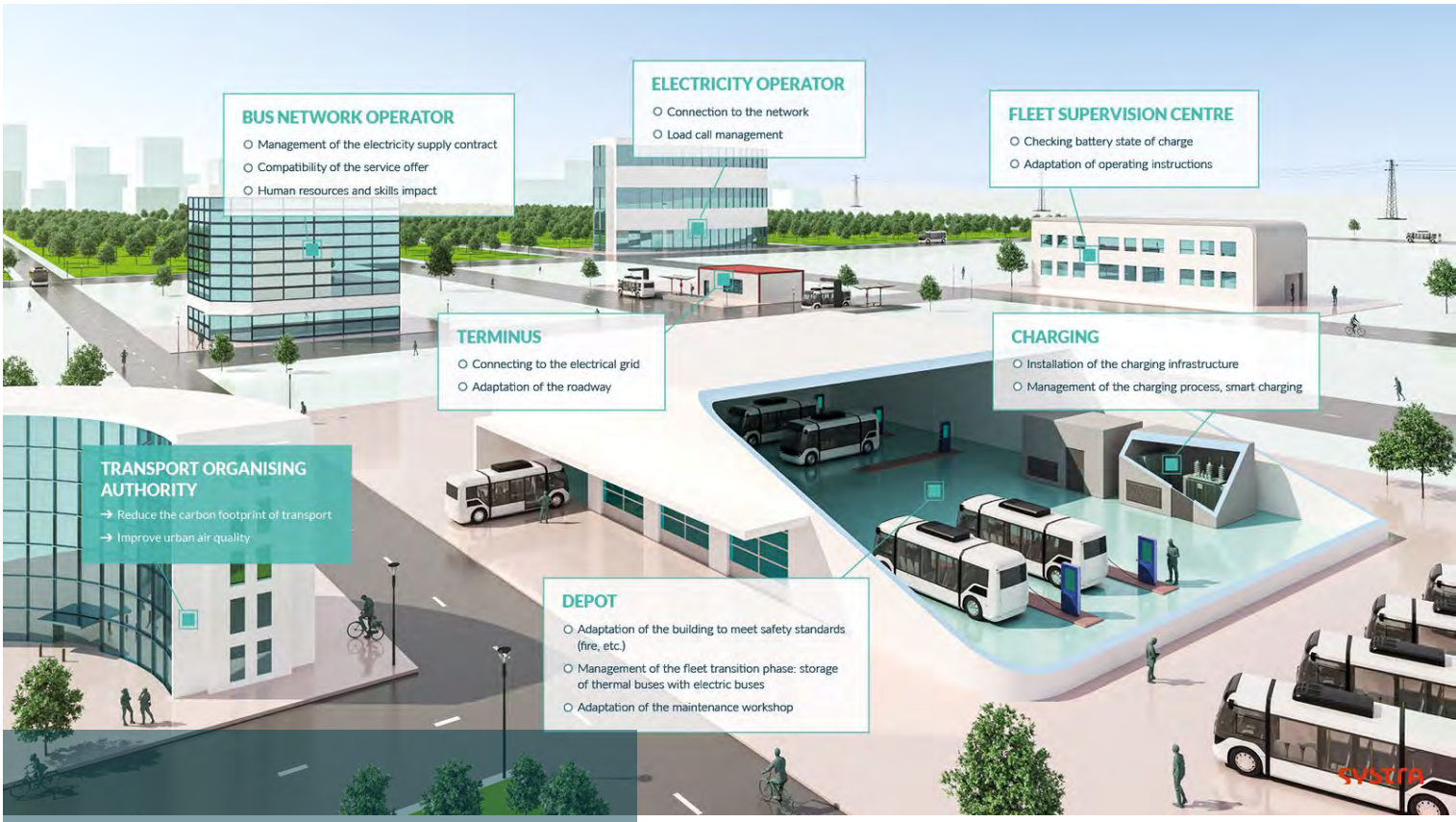
As an integral member of the program manager/owner's representative team, SYSTRA provided specialized oversight and management expertise in systems and vehicle engineering to develop and implement Project Connect. The program is to expand transit options throughout the Austin, TX, area, with a new light rail system.

SYSTRA led the transit technology evaluation component of the program for light rail vehicles and train control during the environmental phase. This involved oversight and support for the light rail train control system (CBTC and conventional cab signaling--the selection of train control technology will be selected in the next phase of the project) and development of the light rail vehicle technical specification and design criteria.

We developed the train control interface criteria for the light rail system. Our work included the vehicle elements, including equipment layout and arrangement, onboard train control network connectivity, train control integration to the yard and shop information, and train control wayside elements for vehicle and civil interface, operations control center, and back-up operational control center.

SYSTRA performed systems planning and spatial clearances to allow either technology to be implemented in a future phase of the project for the vehicle, wayside, and control center.

Our knowledge of electric mobility solutions from GoA0 to GoA4 helped shape project modes, alternatives, and technologies choices.



Transition to Clean Bus Transportation

The transition to zero-emission vehicles is a pivotal strategy in reducing greenhouse gas (GHG) emissions. Recognizing this initiative, SYSTRA has positioned ourselves at the forefront of the electrification revolution, offering comprehensive services for fleet electrification projects.

The conversion of diesel bus fleets to an all-electric fleet presents challenges across all project phases. We have developed the requisite tools and expertise to navigate these challenges, ensuring a seamless and successful delivery for our clients. From initial planning to operational deployment, our holistic approach addresses every aspect of fleet electrification, safeguarding against potential pitfalls and maximizing project outcomes.

One of our primary objectives is to optimize investment costs by sizing the charging infrastructure in alignment with your operational needs. By tailoring infrastructure requirements to real-world usage patterns, we ensure efficient resource utilization without compromising operational effectiveness.

As advocates of low-carbon mobility, transportation operators are under increasing pressure to enhance their infrastructure and fleets, embracing electromobility solutions to mitigate their environmental impact. Beyond GHG emissions reduction, the transition to electric buses yields additional benefits, notably the reduction of noise pollution, thereby enhancing the quality of life for urban dwellers.

SYSTRA's commitment to operational excellence is reflected in our proactive approach to supporting clients throughout their electrification journey. Our experienced team collaborates closely with stakeholders to develop tailored electromobility roadmaps, aligning strategic objectives with practical implementation strategies.

Metrobus Network Electrification in Quebec

In response to the growing demand for services, the Réseau de transport de la Capitale (RTC) is expanding its bus fleet. The current fleet is comprised of 615 vehicles across two sites. This expansion aligns with the Quebec government's Sustainable Mobility Policy and commitment to a green economy. From 2025 onwards, transportation companies will exclusively receive financing for the acquisition of 100% electric vehicles, driving the transition towards eco-friendly transportation solutions.

SYSTRA is a leader in the consortium responsible for the development and electrification projects at the Newton Center and Metrobus Center.

For the Newton Center, the team prepared a comprehensive Functional and Technical Program (FTP) and created two concepts for the facility, optimizing space and incorporating expansion opportunities.

For the expansion, redevelopment, and electrification of the Metrobus Center, the team prepared an FTP and generated a concept tailored to the facility's requirements.

For both projects, the team completed a range of critical tasks, including:

- Conducting thorough studies and analyses to inform decision-making.
- Providing accurate budget estimates, design iterations, and construction schedules for each project phase and concept option.
- Offering ongoing support for monitoring project schedules, costs, and quality standards
- Implementing sustainable design strategies to minimize environmental impacts and enhance long-term viability.
- Facilitating collaborative processes, risk management, and value analysis workshops to ensure project success and stakeholder alignment.

By leveraging our expertise and innovative solutions, we are driving the evolution towards greener, more efficient transportation systems that benefit present and future generations.

Powering US Rail Systems

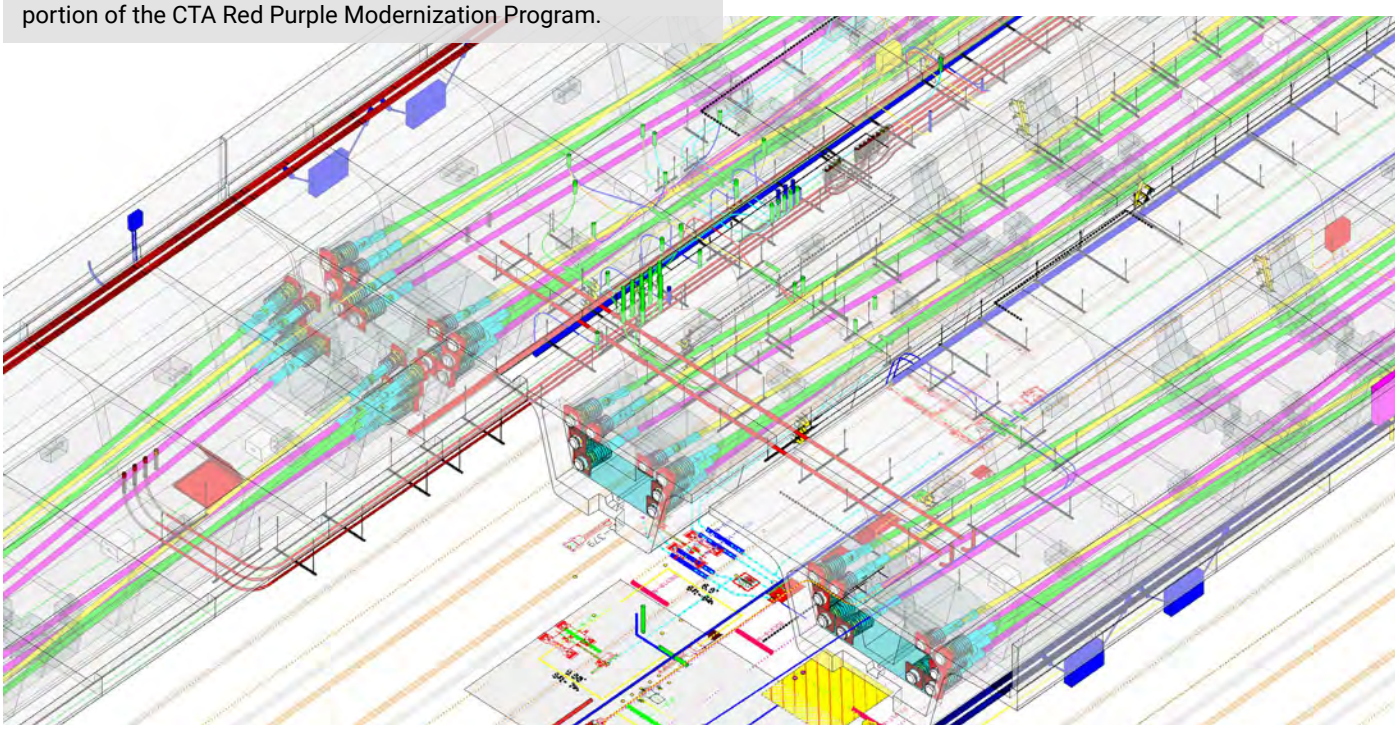
The electric power system plays a crucial role in every transportation system, and a well-designed system can greatly enhance system reliability, passenger comfort, and safety, while helping to minimize annual operating costs.

SYSTRA's electrical and traction power group includes engineers and designers with diverse engineering backgrounds, which is essential to the successful analysis, design, and construction of the many power distribution systems throughout the rail and transit industry.

SYSTRA provides design and construction services for AC and DC traction power and facility power systems in major cities across the US. Our services include:

- Traction power
- Facility power
- Overhead contact systems
- Power systems analysis
- Corrosion control

SYSTRA created this BIM digital model of the segmental bridge portion of the CTA Red Purple Modernization Program.



Capabilities

Facility Power

- AC substation design and modifications
- Indoor/outdoor lighting and power distribution
- Railway stations and repair facilities
- Bus garages and commercial buildings
- Safety programs and audits
- Value engineering studies
- Safety programs and audits

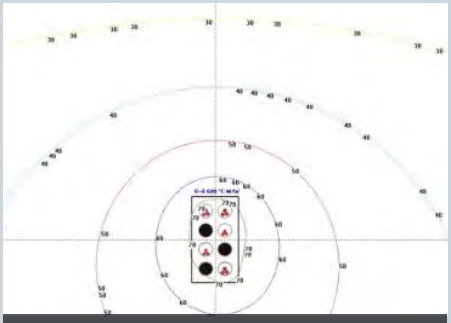
Power Systems Analysis

- Train performance simulations
- Catenary voltage profiles
- Load flow analysis
- Short-circuit analysis
- Protective coordination
- Motor starting studies
- Arc flash hazards analysis
- Ground grid sizing
- Battery sizing
- Lightning protection
- Harmonic studies
- Cable ampacity studies

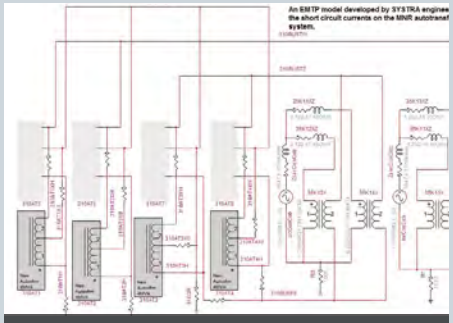
Corrosion Control

- Corrosion analysis
- Stray current management
- Systemwide grounding and bonding
- Cathodic protection design

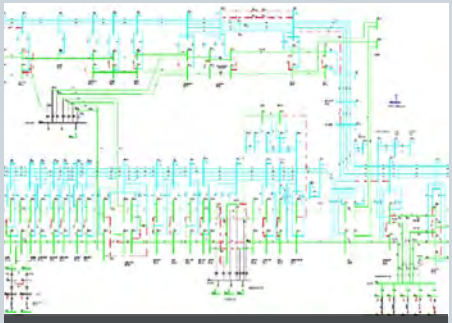
Tools



SYSTRA performed a cable ampacity study of a 34.5 kV duct bank.



SYSTRA developed this EMTP model to study the short circuit currents on Metro-North's autotransformer system.



PSSE of the entire Amtrak 25Hz system.

- Building Information Modeling (BIM) for catenary, buildings, substations, underground electrical: Civil 3D, Revit
- AC and DC traction power simulation: RAILSIM, Esmeralda, Marcadet
- Raceway and cable design: CYMCAP
- Catenary structural design: Bentley RAM Elements, L-Pile
- Miscellaneous tools:
  - Building system studies: SKM, ETAP
  - Lighting design: Visual Lighting
  - Power system studies: EMTP RV, PSSE
  - Grounding studies: XGS Lab

Traction Power **Design**

From New York and Philadelphia to Chicago and Los Angeles, SYSTRA's electrical and traction power group designs and supports the construction of switchgear and substations, frequency converters, rectifiers, and distribution equipment.

Our traction power design expertise includes:

- AC substation design (25 Hz, 60 Hz)
- DC substation design (rectifier systems)
- Protective relaying systems
- Signal power systems
- Equipment design specifications
- Equipment procurement
- Specifications
- Construction support services

Metropolitan Washington Airports Authority Dulles Corridor Metrorail Rail Yard and Maintenance Facility: Engineer of Record for the traction power and medium voltage distribution systems

> SYSTRA performed the design of the traction power system for the Dulles Rail Yard Design-Build Project. Right after Mr. Natenzon took over managing the traction power design department, the SYSTRA-MCD team did a 180° turn to improve the design, quality, and coordination, eliminate risk, and reinstate client trust. Mr. Natenzon not only has strong engineering capabilities, but also has the ability to communicate and establish a very strong connection with the client-- listening, understanding, and addressing client concerns.
>
> This included M.C. Dean, Hensel Phelps, MWAA, and WMATA. Another positive and powerful characteristic of Mr. Natenzon is his ability to manage his team of engineers who were knowledgeable, had the right expertise, and responded promptly. Mr. Natenzon was always available, after office hours and on weekends, which is invaluable.
>
> Willy Lizarraga, Operations Manager
> M.C. Dean, Inc.

> SYSTRA performed system studies on the Metro-North traction system since the early 2000s. The projects include traction power studies on DC territory and the New Haven Line relay settings, Anchor Bridge Substations Protective Relaying Coordination Investigation and Study, Upper Harlem Line Substation Siting Study, Traction Power System Study for 2013 Operations with Final M-8 Deployment, Harlem/Hudson Lines Substation Improvements DC Protection Study Final Report, Shore Line East Traction Power Study for 2030 Operations, and New Haven Line protective relay settings for six new substations. All projects were completed satisfactorily, on-time, and within budget. These studies are used by the MTA to determine system upgrades, locations of new substations, and sizing reactors, among other technical issues.
>
> Paul Cooper, PE, Assistant Chief Engineer, Design & Construction
> Metro-North Railroad

Overhead Contact **Systems**

Our Services

- Full-service OCS engineering and design
- OCS modifications related to bridge replacements
- Structural design of OCS supporting structures
- OCS modifications related to new stations
- Rail yards and shops electrification
- Transmission tower replacements
- Construction support services

Designing an overhead contact system (OCS) for rail and transit involves intricate planning and engineering to ensure safe, reliable, and efficient power supply to trains.

SYSTRA's expertise in OCS design for rail and transit encompasses a broad range of disciplines from electrical and structural engineering to project management, compliance, and safety.

Our goal is to create robust infrastructure that supports efficient train operations while prioritizing safety, reliability, and environmental responsibility.

California High-Speed Rail **Track and OCS Design**

SYSTRA is in a joint venture to deliver a comprehensive, efficient, and state-of-the-art track and OCS design for the initial 171-mile high-speed rail passenger service connecting Merced to Bakersfield, CA.

We are playing a critical role in the program's overall success, managing intricate design interfaces, collaborating with future contracts, and supporting seamless integration with key stakeholders.

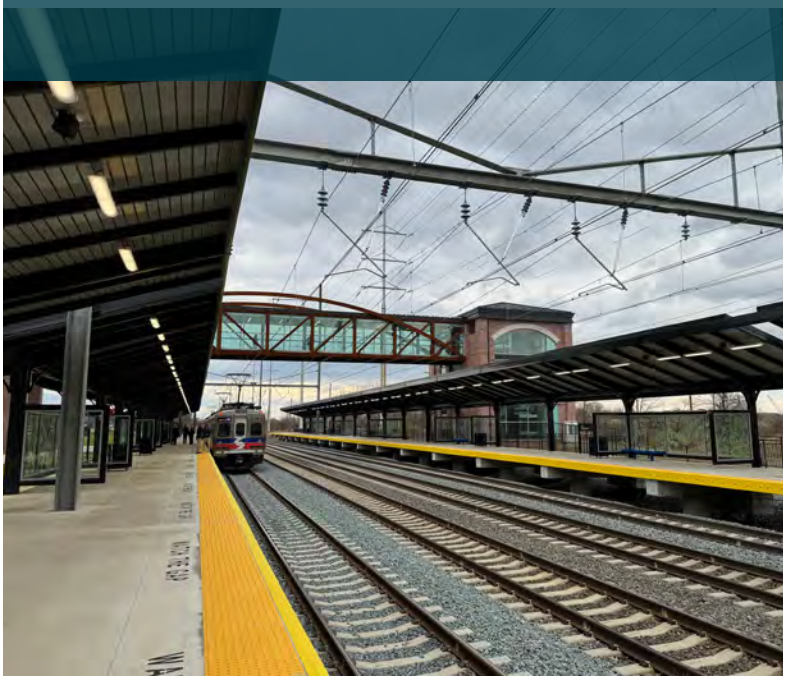
This landmark endeavor marks the first high-speed rail track and OCS initiative in the United States, setting a new standard for transportation infrastructure. Our team will be integrated with the Authority in Sacramento to deliver this transformative project.

SYSTRA is leading the OCS design and associated work that takes place in two primary phases — design principles and detailed design. Our scope includes:

- Reviewing the designs and/or as-build documentation of Construction Packages 1, 2-3, and 4 to ensure integration with our OCS design.
- Developing a design principles report and detailed design for the OCS system.
- Supporting and providing input to the Authority regarding the selection of the OCS system.
- Verifying that the OCS design considers expansion to San Francisco, Los Angeles, and Sacramento.
- Ensuring our design complies with European Standards/Technical Specifications for Interoperability (EN/TSI)
- Developing 100% design document for the the entire 171 mile OCS system.

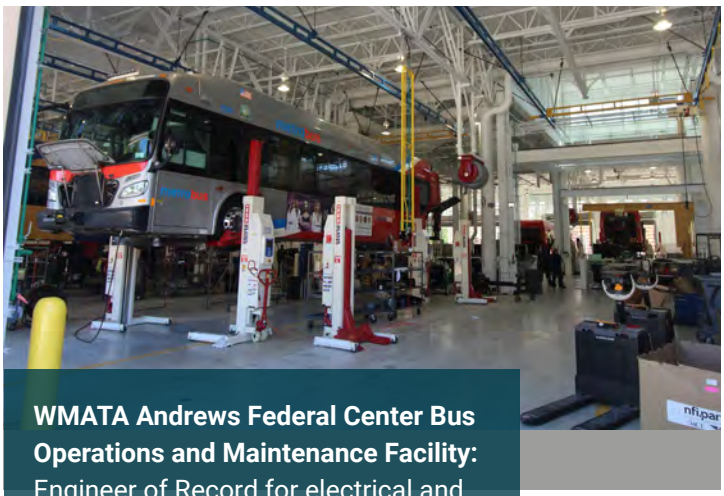
Metropolitan Council of Greater Minneapolis Hennepin County Interchange Light Rail System: Engineer of Record for traction power and OCS systems

Delaware DOT Claymont Regional Transportation Center: Engineer of Record for OCS and communications



Washington, DC DOT Streetcar: Engineer of Record for OCS and communications

CTA Red Purple Modernization Program: Engineer of Record for corrosion analysis, stray current management, systemwide grounding and bonding, and segmental bridge design



WMATA Andrews Federal Center Bus Operations and Maintenance Facility: Engineer of Record for electrical and communications systems

Amtrak Jericho Static Frequency Converter: Engineer of Record for substation modifications

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